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Overestimation of Black Carbon Direct Radiative Forcing from Biomass Burning in Southeast Asia

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Black carbon (BC) has significant climate effects, yet large uncertainties remain in estimating its radiative forcing. BC is commonly treated in models without species differentiation, and the varied origins and optical properties of Char and Soot could contribute to the uncertainties. Radiocarbon-based source apportionment unveiled open biomass burning (OBB) boosting BC mass by around two times in northern Thailand, a key OBB region, with Char comprising over 90% of the increment. The mass absorption efficiency (MAE) of BB-derived Char was considerably lower than that of fossil-fuel burning, while Soot's MAE remained consistent across emission sources. Using observational MAE constraints, we found the conventional BC direct radiative forcing (DRF) could have been overestimated by 15% (0.46 W m^{-2}), with BB-derived BC overestimated by 27% (0.63 W m^{-2}). We call for enhancing observational efforts to constrain BC sub-types to re-evaluate BC DRF, especially as global warming intensifies biomass burning.